CLAIMS

What is claimed is:

1. A method for classifying a communication signal, comprising:

decomposing a subject signal into subbands;

determining a presence of energy in the respective subbands corresponding to at least one sinusoid in the subject signal; and

filtering said at least one sinusoid to classify the signal.

2. The method according to Claim 1, wherein decomposing the subject signal into subbands includes PS-IIR filtering.

3. The method according to Claim 1, further including engaging a preclassifier to estimate a frequency of a given sinusoid.

4. The method according to Claim 3, wherein estimating the frequency of the given sinusoid includes modeling the given sinusoid.

5. The method according to Claim 4, wherein modeling the sinusoid includes solving a second-order, auto-regression equation.

6. The method according to Claim 3, wherein estimating the frequency of the given sinusoid includes accessing a look-up table having pre-determined ranges of data corresponding to the frequency of the given sinusoid.

7. The method according to Claim 6, wherein the ranges of data are adjusted to account for estimation error due to finite signal length.

8. The method according to Claim 3, further including windowing the subband prior to estimating the frequency of the given sinusoid.

9. The method according to Claim 8, wherein windowing includes employing an N-point triangular window.

10. The method according to Claim 1, wherein classifying results in classifying the signal as one of the following signal types: DTMF, MF-R1, ANS(V.25), LEC_DIS, V.21, or AA.

11. The method according to Claim 1, wherein determining a presence of energy in the respective subbands includes narrowing classification possibilities as a function of the presence, or absence, of energy in the respective subbands.

12. The method according to Claim 11, further including notch filtering at select frequencies estimated to be sinusoid frequencies in the signal to further narrow classification possibilities.

13. The method according to Claim 1, wherein decomposing the subject signal significantly reduces the bandwidth of the subbands compared to the subject signal.

14. The method according to Claim 1, further including processing the subject signal in predetermined frame sizes.

15. The method according to Claim 14, wherein the frame sizes are 10msec in length.

16. The method according to Claim 1, further including reporting the subject signal

signal-type after three consecutive classifications identifying the same signal-type.

17. The method according to Claim 1, wherein classifying results in discriminating facsimile, modem, voice, and DTMF signals.

18. The method according to Claim 1, wherein executing the method uses an order of magnitude fewer processor instruction cycles than traditional methods for classifying communication signals.

19. The method according to Claim 1, wherein the method uses less than about 0.5 MIPS.

20. The method according to Claim 1, wherein plural such methods are operating on a single digital processor.

21. The method according to Claim 1, used in a media gateway.

22. An apparatus for classifying a communication signal, comprising:

a band-splitter decomposing a subject signal into subband signals;

a detector coupled to the band-splitter to determine a presence of energy in the respective subband signals corresponding to at least one sinusoid in the subject signal; and

a filter director coupled to said detector to instantiate at least one filter, said at least one filter being coupled to the detector to receive a subband signal for filtering said at least one sinusoid to classify the subject signal.

23. The apparatus according to Claim 22, wherein the band-splitter includes at least one PS-IIR filter.

24. The apparatus according to Claim 22, further including a preclassifier to estimate a frequency of a given sinusoid.

25. The apparatus according to Claim 24, wherein the preclassifier uses an automated modeling technique to determine the frequency of the given sinusoid.

26. The apparatus according to Claim 25, wherein the automated modeling technique solves a second-order, auto-regression equation.

27. The apparatus according to Claim 24, wherein the preclassifier accesses a look-up table having pre-determined ranges of data corresponding to the frequency of the given sinusoid.

28. The apparatus according to Claim 27, wherein the ranges of data are adjusted to account for estimation error due to finite signal length.

29. The apparatus according to Claim 24, wherein the preclassifier uses a window to filter the subband signal prior to estimating the frequency of the given sinusoid.

30. The apparatus according to Claim 29, wherein the window is an N-point triangular window.

31. The apparatus according to Claim 22, wherein the signal is classified as one of the following signal types: DTMF, MF-R1, ANS (V.25), LEC_DIS, V.21, or AA.

32. The apparatus according to Claim 22, wherein the detector narrows classification possibilities as a function of the presence, or absence, of energy in the respective subband signals.

33. The apparatus according to Claim 32, wherein the filter director instantiates notch filters at select frequencies estimated to be sinusoid frequencies in the subject signal to further narrow classification possibilities.

34. The apparatus according to Claim 22, wherein the subband signals are significantly reduced in bandwidth compared to the subject signal.

35. The apparatus according to Claim 22, further including a frame-size control unit to control frame sizes of the signal being processed to be in predetermined frame sizes.

36. The apparatus according to Claim 35, wherein the frame sizes are 10msec in length.

37. The apparatus according to Claim 22, further including a reporting unit that reports the subject signal signal-type after three consecutive classifications identifying the same signal-type.

38. The apparatus according to Claim 22, discriminating facsimile, modem, voice, and DTMF signals.

39. The apparatus according to Claim 22, wherein executing the method uses an order of magnitude fewer processor instruction cycles than traditional methods for classifying communication signals.

40. The apparatus according to Claim 39, wherein classifying the signal uses less than about 0.5 MIPS.

41. The apparatus according to Claim 22, wherein said band-splitter, said detector,

and said filtered director are incorporated on a single digital processor.

42. The apparatus according to Claim 22, wherein the apparatus is used in a media gateway.

43. An apparatus for classifying a communication signal, comprising:

means for decomposing the signal into subbands;

means for determining a presence of energy in the respective subbands corresponding to at least one sinusoid in the decomposed signal; and

based on said at least one sinusoid, means for classifying the signal.

44. A computer-readable medium having stored thereon sequences of instructions, the sequences of instructions including instructions, when executed by a digital processor, causes the processor to perform:

decomposing a subject signal into subbands;

determining a presence of energy in the respective subbands corresponding to at least one sinusoid in the subject signal; and

filtering said at least one sinusoid to classify the signal.

45. An apparatus, comprising:

a receiver to receive at least one analog signal having a protocol from among plural communication protocols;

an analog-to-digital converter to convert said at least one analog signal to a corresponding digital signal; and

a digital processor coupled to an output of the analog-to-digital converter to process the digital signal, the digital signal processor executing program instructions to:

decompose the digital signal into subbands;

determine a presence of energy in the respective subbands corresponding

to at least one sinusoid in the decomposed digital signal; and

filter said at least one sinusoid to classify the received analog signal.

46. An apparatus, comprising:

means for receiving at least one analog signal having a protocol from among plural communication protocols;

means for converting said at least one analog signal to a corresponding digital signal; and

means for processing the digital signal, including:

means for decomposing the digital signal into subbands;

means for determining a presence of energy in the respective subbands corresponding to at least one sinusoid in the decomposed digital signal; and

means for filtering said at least one sinusoid to classify the received analog signal.

47. The apparatus according to Claim 46, wherein the apparatus is a gateway coupled to a network.

48. An apparatus, comprising:

means for receiving at least one signal having a protocol from among plural communication protocols;

means for decomposing the signal into subbands; and

means for classifying the received signal based on the signals in the respective subbands.

49. A central office, comprising:

a first interface coupled to a first link to a digital network;

a second interface coupled to a second link to at least one subscriber terminal in the digital network; and

a classifier coupled to said first and second interfaces, said classifier being employed to:

decompose a subject signal into subbands;

determine a presence of energy in the respective subbands corresponding to at least one sinusoid in the decomposed signal; and

filter said at least one sinusoid to classify the signal.

50. A method for classifying a communication signal, comprising:

reducing an input signal into two lower-bandwidth signals;

detecting the presence of at least one sinusoid in the lower-bandwidth signals; and

verifying said at least one detected sinusoid is of a frequency corresponding to a frequency indicative of one of plural communication protocols such that the input signal is classified according to the one protocol.

51. The method according to Claim 50, wherein reducing the input signal into two lower-bandwidth signals includes:

sampling the communication signal with an A/D converter; and

filtering the sampled signal with at least one PS-IIR filter.

52. The method according to Claim 50, wherein detecting the presence of at least one sinusoid includes:

measuring energies in the lower-bandwidth signals; and

comparing the energies to expected energy levels.

53. The method according to Claim 50, wherein verifying said at least one detected sinusoid includes:

filtering said at least one sinusoid with at least one corresponding filter; and

for each filter, comparing the output of the filter to the input of the filter to

test (i) the energy level and frequency of individual sinusoids, and, if applicable, (ii) the difference in magnitude of the energy levels of the two sinusoids composing the indications of a communication protocol employed by the communication signal.

54. The method according to Claim 50, further including determining the signal to be a facsimile, modem, voice, or DTMF signal.